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East Europe Report

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ORDINANCE ON NUCLEAR SAFETY IN USE OF RESEARCH REACTORS

Sofia DURZHAVEN VESTNIK in Bulgarian 29 Apr 83 pp 451-461

[Text] State Committee for Science and Technical Progress

Committee for the Peaceful Utilization of Atomic Energy

Ordinance No 2 on Nuclear Safety in the Use of Research Reactors

Chapter One

General Stipulations

Article 1. The present ordinance defines the basic technical and organizational requirements governing nuclear safety in designing, building, starting up and operating research reactors, and requirements related to the organization of the work and the training and qualifications of the personnel.

Article 2. The ordinance regulates the safety of the research reactor in terms of preventing loss of control and management of the fission chain reaction in the active area of the reactor, excluding the possibility of the development of a critical mass outside the active zone in the course of the transportation and storage of the nuclear fuel and preventing the damaging of heat releasing elements above admissible levels as a result of disturbances in the technological process in the course of the use of the reactor.

Article 3. In order to ensure the nuclear safety of research reactors, the reactors and their equipment must be made technically perfect; control of technological processes in the use of the reactor must be safe, the work must be properly organized and the personnel must display high professional skills and strict discipline.

Chapter Two

Technical Stipulations Related to the Reactor's Design and Equipment

Section I

General Stipulations

Article 4. (1) The reactor's design must contain technical and organizational stipulations aimed at ensuring nuclear safety under normal working conditions

and emergency systems which, should any breakdown in the reactor's system were to occur, could coincide with a lengthy and undetected breakdown of another system.

(2) The list of possible systems breakdowns included in the reactor's design, in terms of ensuring nuclear safety, must be cleared with the Committee on the Peaceful Utilization of Atomic Energy (KMIAE).

Article 5. The design of reactor systems and mechanisms, the breakdown or malfunctioning of which may affect nuclear safety must include a study of the consequences of possible breakdowns of structural elements, singling out dangerous breakdowns and assessing their consequences. Such systems and mechanisms must be provided with control instruments and, if necessary, have backup systems.

Article 6. The multipurpose use of the reactor's systems and mechanisms will not be permitted unless proven that such combination of functions will not violate nuclear safety stipulations and requirements.

Article 7. (1) The systems and individual mechanisms of the reactor, which may affect nuclear safety must be controlled and tested in the course of their manufacturing, assembling, tuning and periodical testing in the course of their operation. The blueprints must call for attachments, apparatus and methods for:

1. Checking the functioning of the most important parts of the systems and mechanisms;

2. Periodical testing of systems and mechanisms for consistency with design indicators;

3. Periodical control of the sequence and time of the signal, including signals indicating that the emergency safety systems are engaged;

4. Checking the engaging of the equipment, including conversion to emergency power sources.

(2) The Control equipment and methods should not be such as to affect the safe operation of the reactor.

(3) The blueprint must include a list of systems and equipment the operability of which may be checked on a functioning or idling reactor.

Article 8. The technical characteristics of the instruments for control and safety of control-measuring equipment and apparatus must be such as to allow the determination of the reasons for triggering the emergency safety systems. The volume of resulting data should suffice for purposes of providing a full description of the breakdown process.

Article 9. (1) The reactor signalling system must issue the following signals:

1. Breakdown (light and sound, including a siren for breakdown notification) when the threshold of activation of the emergency system has been reached;

2. Warning (light and sound), should the parameters get close to the activation of the emergency system, should the radiation level exceed stipulated thresholds or should the normal functioning of the equipment be disturned.

3. Indicative, identifying the status of the working parts of the control and safety system, tension in the power feeding circuits, condition of the equipment, activation of individual instruments, etc.

(2) The number of signalling devices must be determined separately for each individual reactor and its experimental systems.

Article 10. The reactor's systems aimed at ensuring nuclear safety and preventing or reducing the consequences of a nuclear accident must be designed, manufactured and installed with a view to the additional loads which may occur under the influence of weather conditions and natural phenomena characteristic of the specific area, such as earthquakes, hurricanes, floods, etc.

Article 11. (1) The reactor's blueprint must meet the stipulations of this ordinance and cleared with the KMIAE in terms of ensuring nuclear safety.

(2) The following materials must be submitted for approval by the KMIAE no less than 60 days before it can approve the blueprint for building a reactor:

1. Explanatory note, which includes problems of the physical aspects of the reactor, such as:

a. charging the active zone;

b. reactivity balance;

c. efficiency of the operating parts of the control and safety system;

d. reactivity effects;

e. influence of experimental systems on reactivity, etc.

2. Explanatory note for the reactor's control and safety system, which includes:

a. a description of the control and safety system;

b. the logical structure system;

c. description of control and safety channels;

d. list of accident identification signals, etc.

3. Technical substantiation of the safety of building and operating the reactor.

4. Other data related to the implementation of the stipulation of the present ordinance.

Section II

Reactor Design Stipulations

Article 12. (1) The designing of the active area of the reactor and its experimental systems must be preceded by the definition and substantiation of the conditions for the safe operation of admissible breakdown thresholds (amount and level of damage) of heat releasing elements.

(2) The active area of the reactor and the experimental systems must be so designed that under the conditions of normal operations and while the reactor is working the admissible thresholds of damage caused to heat releasing elements are not exceeded.

Article 13. In designing the reactor the full capacity coefficient of reactivity must be negative for all operational systems. Should it prove positive under some operational conditions the design must provide for and specifically prove the nuclear safety of the reactor at work under stationary, transitional and dangerous conditions.

Article 14. The design of the reactor and the active zone must be such that under normal or accident operational conditions of the reactor the possibility of wedging the working parts of the control and safety systems be excluded.

Article 15. The active zone of the reactor must be so designed as to exclude the possibility of an unforeseen shifting of the elements of the active zone or the accidental change of the zone's structure and configuration.

Article 16. The features of the nuclear fuel, reactor design and equipment of the first contour with auxiliary systems, including the heat carrier flushing system, must be such as to exclude the possibility that a critical mass may form in the destruction of the active zone or as a result of fuel melting.

Article 17. The features of the nuclear fuel, the location of heat releasing elements, the moving parts of the control and safety system and the other systems in the active zone, which affect reactivity must exclude the possibility of the appearance of local critical masses.

Article 18. If necessary, the reactor's design must include an emergency cooling system such as to prevent the damaging of heat generating elements beyond admissible limits should the normal heat conductor system malfunction.

Section III

Stipulations Applicable to the Reactor's Experimental Systems

Article 19. (1) The reactor's experimental systems should not be such as to create conditions for the appearance of a local critical mass and a distortion of the energy release field capable of damaging the heat release elements.

(2) The experimental systems must be designed in such a manner as to exclude the possibility of their unforeseen shifting which may result in reactivity changes.

Article 20. Assembling or disassembling of experimental systems should not be such as to result in an unforeseen shifting of the other systems and elements of the reactor's active zone.

Article 21. If necessary, the experimental systems must be equipped with detectors to control the neutron flow and thermophysical parameters.

Article 22. (1) The control signals of the basic parameters of the experimental systems must be located on the control panel and if necessary connected to the reactor's safety breakdown system.

(2) The activating of the signals of the experimental systems within the regular reactor control and safety system should not be such as to worsen the ability of the breakdown safety system to perform its safety functions.

Article 23. The speed of increase of reactivity in work with the experimental systems may not exceed $0.07\beta ef/sec$. Should the introduced reactivity exceeds $0.7\beta ef$, the increase must not exceed steps of $0.3\beta ef$.

Article 24. (1) The reactor's experimental systems manufactured and installed in the course of its operations (prototypes, channels, etc.) should be supplied with technical documentation which will include estimated or experimental assessments of their impact on reactivity.

(2) Should this require an increase in the efficiency of the active parts of the control and safety system compared with the design, the installation of the experimental systems must be cleared with the KMIAE.

Section IV

Stipulations Related to the Control and Safety System

Article 25. The control and safety system must provide reliable control over the power (intensiveness of the chain reaction) to control and stop in case of emergency the chain reaction and maintain the reactor in a subcritical condition.

Article 26. (1) In terms of functional significance, the working parts of the control and safety system are subdivided into:

1. Breakdown safety;

2. Automatic control;

3. Compensation.

(2) The combination of the functions of the working parts of the control and safety system is allowed under the stipulations of Article 6.

Article 27. The working parts of the control and safety system must have status indicators and terminal switches activated if possible by the working part. Indicators showing intermediary positions are not mandatory in the case of working parts of the safety system.

Article 28. The safety protection system must carry out its protective functions independently of external power sources and have no less than two channels for controling the power level, indicators of their position and extremal disengaging switches of the working parts in the control and safety system.

Article 29. The electrical circuit of the control and safety system must be such as to exclude possible reactivity increases through the working parts, should the working parts of the breakdown safety system become inoperative.

Article 30. Reactivity must be lowered as quickly as possible when developing the safety system and in cases of malfunction of the working parts of the control and safety system.

Article 31. The velocity at which the reactivity of the working parts of the control and safety system increases must not exceed 0.07β ef/sec. In the case of working parts with an efficiency higher than 0.7β ef, reactivity increases must not exceed steps of 0.3β ef; an additional possibility for stopping the reactor supply at the control panel must be envisaged.

Article 32. The control and safety system must be able to deal with the unforeseen removal (within the limits of planned velocities) of simultaneously working parts for purposes of tuning off the most efficient part in such a way as not to allow any increase in power which may exceed the limit beyond which heat releasing elements or experimental systems may be damaged.

Article 33. The technical documentation of the control and safety system must include a study of the behavior of the system in the case of possible malfunctions, such as short circuits, damaged insulation, drop of tension, etc.

Article 34. The control and safety system must be tested for malfunctions prior to the initial start-up of the reactor.

Article 35. (1) The reactor and its main systems must be governed from the control panel linked by telephone and loudspeaker lines to the reactor room and, if necessary, to other premises. The reactor room and location site must be visible from the control panel directly or through a television hookup.

(2) The possibility of stopping the reactor from another premise, should this prove to be impossible from the control panel must be foreseen.

Article 36. (1) In order to keep the power (intensiveness of the chain reaction) under control, the reactor must be equipped with control channels in such a way that should a critical situation develop, and at any capacity level control over the neutron flow must be maintained with the help at least four independent channels:

1. Two channels for measuring the power level with visual and recording instruments;

2. Two channels for measuring the speed of power increase (or reactivity) with reading instruments.

(2) If the channels used for such measurements have a limited operational range the work span of the respective channels must be backed with a span no less than double their own.

(3) The power level of the reactor must be recorded at all times.

Article 37. (1) The breakdown safety of the reactor must be such as to ensure its automatic stop should a breakdown signal be received.

(2) The time for installation of the working parts of the control and safety system, signals and safety thresholds must be substantiated in the design.

Article 38. (1) The breakdown safety of the reactor must be designed in such a way as to ensure in the course of its start-up or at any level of power its safety with a minimum of four independently functioning channels:

1. Two channels for safety at a power increase speed in excess of 1 percent of nominal power.

2. Two channels for safety at a velocity in excess of $10^{-3\%}$ of nominal power.

(2) If the safety channels are operational within a limited range, their operational ranges must be at least doubled. The switching over of the ranges should not prevent the engaging of the breakdown safety working parts or extend their start-up time. The breakdown safety system must become engaged according to the signal issued through any one of the channels.

(3) If the number of channels of the breakdown safety system is more than two in terms of power or velocity increase, the breakdown safety system may be engaged if the signal of any two channels of a given type coincide, in order to reduce the number of false alarms.

(4) The safety system based on the speed of growth of velocities in operating a reactor in a stationary condition with an automatic regulator may be disconnected. In converting to manual control or changing the level of power the automatic reconnecting of the safety system, based on the velocity of power increase, must be ensured.

Article 39. In the use within the control and safety system of the minimally admissible breakdown safety channels and the control channels stipulated in Articles 36 and 38, the work of the reactor must be stopped whenever any of said channels is undergoing repairs.

Article 40. The autonomy of the breakdown safety channels must be such that any damage caused to them will not disturb the functions of the breakdown safety system.

Article 41. The combined use of the control and breakdown safety channels is allowed. The channels controlling the power level and the velocity of its increase may be used jointly with the channels for breakdown safety for the level of power and increase in velocity. The breakdown or inoperability of an element or system of the jointly used channels should not be able to prevent the breakdown safety system from performing its protective functions.

Article 42. The breakdown safety system of the reactor must be triggered automatically in the following cases:

1. When the breakdown power level has been reached;

2. When the breakdown level of the power increase velocity has been reached;

3. When the tension along the circuits powering the control and safety system has been lost;

4. In the case of malfunction or inoperable condition of any given channel of the breakdown safety system (in the case of two operating channels);

5. If technological breakdown signals requiring the stopping of the reactor have been received;

6. By pushing the breakdown safety buttons.

Article 43. The breakdown level based on doubling capacity thresholds should be no shorter than 10 seconds and the warning no shorter than 15 seconds.

Article 44. The breakdown safety system should have no less than two indepen-debt groups of working parts, which must be automatically switched on in the case of a breakdown signal.

Article 45. The number, location, efficiency and speed of the engagement of the working parts of the breakdown safety system must be defined in the reactor's design, which must indicate the way the working parts of the breakdown safety system must ensure in all breakdown situations the following:

1. Adequate speed emergency reduction of the reactor's power, not resulting in any damage to the heat generating elements above admissible levels;

2. The disconnecting and maintaining of the reactor in a subcritical condition, taking into consideration possible reactivity changes in the course of time, in such a way as to make it possible to connect other slower working parts of the control and safety system.

Article 46. The subcritical active area after the removal of the working parts of the breakdown safety system with fully connected remaining working parts of the control and safety system must be higher than 0.01 $K_{ef} < 0.99$ during the campaign period and the status of the active area with a maximal effective multiplication coefficient, which includes the reactivity introduced by the experimental systems.

Article 47. (1) The breakdown safety system must be designed in such a way that its functions are carried out to their completion once activated.

(2) If a breakdown signal has been received it should be possible to activate the working parts of the breakdown safety system regardless of their intermediary position.

Article 48. The breakdown safety system should make it possible to check the transmission of breakdown signals from the gauges to the driving mechanisms of the working parts.

Article 49. The reactor must have an automatic power control system.

Article 50. The design of the control and safety system must include the following:

1. The range of power of the reactor within which control is automated;

2. The precision with which this power is maintained.

Article 51. The intensity and location of the neutron source must be such that its introduction into the fuel-free reactor is paralleled by a noticeable change in the readings of the power control channels.

Article 52. The moving of the neutron source must be done through remote control. The activating of the reactor must be stopped if the source is not in an operating position.

Chapter Three

Start-Up of the Research Reactor

Section I

General Stipulations

Article 53. The start-up of the reactor following the completion of the construction and installation operations and the staffing and training of the personnel includes the following steps:

1. Implementation of start-up operations and testing of systems ensuring nuclear safety;

2. Processing the technical and operational documentation;

3. Physical and power start-ups (comprehensive testing of the reactor's equipment).

Article 54. The acceptance commission is in charge of accepting the reactor for operational purposes.

Section II

Physical Start-Up

Article 55. The following must be ready for operation and supplied with readiness documents at the beginning of the physical start-up:

1. The reactor;

2. The control and safety system;

3. The system of control-measuring instruments and devices required for the physical start-up;

4. The neutron start-up source;

5. The non-regulation start-up equipment if necessary, from which the signals of breakdown safety are connected to the regulation breakdown safety system of the reactor;

6. The transportation, loading and reloading of the fresh and spent nuclear fuel system;

7. The dosimetric control system;

8. The system for the chemical and special preparation of the heat carrier including the warm-up system (if necessary);

9. The breakdown announcement system;

10. The telephone and loudspeaker systems;

11. The breakdown cooling system if such has been stipulated;

12. Other technological systems required for a physical start-up.

Article 56. during the period of the physical start-up of the reactor the control and safety system must meet the stipulations of Chapter Two, Section IV. The blocking of breakdown safety signals of the technological systems, which are not used during the physical start-up, is permitted.

Article 57. The following set of documents must be available for the physical start-up:

1. Physical start-up program;

2. Methods for conducting the experiments during the physical start-up;

3. Instructions on the operation of the reactor;

4. Breakdown measures plan;

5. Instruction on ensuring nuclear safety in the physical start-up;

6. Instruction governing the transportation and storage of fresh and spent nuclear fuel;

7. Technical documentation of the reactor and the experimental systems, including description of the equipment and the nuclear safety systems;

8. Work documentation, including logbooks, diaries with reactor loading charts, and others;

9. Documents proving the readiness of the control and safety system and control measuring instruments and apparatus pertaining to the reactor and other systems;

10. Order appointing the manager in charge of the physical start-up, his deputies and the group in charge of the physical start-up;

11. Records of the tests conducted by the shift personnel and physicists on duty;

12. Order issued by the reactor's manager admitting the shift personnel who have passed their job qualification examinations to work;

13. Official instructions for the reactor's shift personnel and the physicist on duty, approved by the reactor's manager.

Article 58. (1) The physical start-up program must stipulate:

1. The procedure for loading the reactor with regulation heat generating cassettes;

2. Procedure for raising the reactor to a critical status;

3. Procedure for conducting and describing the experiments.

(2) The following data must be included in the experiment:

1. Neutron-physical parameters of the active reactor zone;

2. Reactivity effects;

3. Characteristics of the personnel in charge of control, compensation and breakdown safety;

4. Distribution of the neutron flow;

5. Effect of the experimental systems on the reactor's reactivity;

6. Distribution of energy release in the reactor;

7. Other data.

(3) The part of the program for the physical start-up dealing with ensuring nuclear safety must be submitted to the KMIAE no later than 60 days prior to the beginning of the start-up as per Article 17, Paragraph 2 of the Regulation on the Application of the Ukase on State Control over Nuclear Safety (DV, No 8, 1981).

Article 59. The instruction on the operation of the reactor must include the regulations governing the reactor's operation under different circumstances and the limits and conditions for safe operations.

Article 60. The instruction on ensuring nuclear safety in the physical start-up must include the following:

1. Measures for ensuring the reactor's nuclear safety in the physical start-up condition;

2. Brief description of the control and safety system, including non-regulation equipment, if such is used;

3. Description of the control and breakdown safety channels;

4. Expected values of the critical mass;

5. Efficiency of the working parts of the control and safety system;

6. Assessment of the influence of heat generating elements, experimental systems and the heat carrier on the reactivity.

Article 61. The reactor's readiness for physical start-up must be checked by:

1. A work commission appointed by the reactor's manager;

2. The KMIAE commission.

Article 62. (1) The work commission checks:

1. The consistency between the design and the actual reactor;

2. The efficiency of the equipment;

3. Availability of records on equipment testing;

4. Documents certifying to the completion of start-up and tuning operations;

5. Availability and processing of the documentation stipulated in Articles 57, 58, 59 and 60;

6. The reactor's personnel readiness for the physical start-up.

(2) The work commission will draw up the official document certifying to the readiness of the systems and the equipment of the physical start-up of the

reactor. The document must be certified in accordance with stipulated procedures.

Article 63. (1) The KMIAE commission checks the following:

1. The document drawn up by the work commission;

2. The readiness of the reactor for physical start-up in accordance with Article 55, in the section dealing with ensuring nuclear safety;

3. The technical documentation as per Articles 57, 58, 59 and 60;

4. The personnel's readiness for the physical start-up.

(2) An official document must be drawn up on the results of the commission's investigation. In the absence of appended remarks the certified document constitutes the permission for undertaking the physical start-up. In the case of remarks preventing the physical start-up the permit may be issued after appropriate actions have been taken on their basis, for which an official document must be drawn up and signed by the reactor's manager.

(3) The KMIAE document on readiness for the physical start-up must note shortcomings which hinder the energy-generating start-up.

Article 64. On the basis of the document drawn up by the work commission and the KMIAE permit, the acceptance commission must make a decision on the initiation of the start-up.

Article 65. The reactor's physical start-up must be based on the approved physical start-up program and the plan-schedule based on it.

Article 66. In the process of reaching the critical mass $\frac{1}{n}$ curves are plotted based on indications of no less than power control channels. In this case at least one of the curves must show a "safe run" reading.

Article 67. The following procedure must be followed in raising the critical mass:

1. The first portion of the heat generating elements with which the reactor is loaded must not exceed 10 percent of the minimal value of the critical mass;

2. After the readings of the control instruments have been taken, the second portion, which must not exceed the first, is charged;

3. Each subsequent portion must not exceed $\frac{1}{n}$ of the value equal to the remainder of the extrapolated value of the parameter consistent with the critical value. The portion is computed on the basis of the $\frac{1}{n}$ curve, which must indicate the least critical value of the parameter;

4. The efficiency of the working parts of the control and safety system is assessed when K=0.98;

5. Any further loading is done by remote control in portions not exceeding 0.3 β ef. If K <0.98 the loading of the zone cannot be continued through remote control or in portions not exceeding 0.3β ef, the reactivity must be lowered in advance by no less than twice the value of the size of the increase in reactivity. This makes it possible to increase reactivity through remote control in steps not exceeding 0.3 β ef. The reaching of a critical condition by the reactor must be accomplished by remote control.

Article 68. The manager of the physical start-up or his deputy must be in charge of managing the physical start-up.

Article 69. The following are responsible for observing nuclear safety in the physical start-up:

1. The manager of the physical start-up and, in the shift, the physicist on duty, for consistency between the accepted work systems in the program and physical start-up methods;

2. The reactor's manager, for the physical start-up; the shift manager and personnel, in accordance with job instructions, in the shift.

Article 70. The implementation of the experimentation programs in accordance with the assignment is carried out by the shift manager and personnel. The physicist on duty manages the experiments and supervises nuclear safety.

Article 71. The instructions diary and operative logbook must include:

1. The orders of the manager of the physical start-up and the reactor's manager;

2. The operations performed by the personnel;

3. The conducted experiments and their results.

Article 72. The results of the physical start-up must be recorded in a special document and report, a copy of which must be sent to the KMIAE.

Section III

Reactor's Power-Generating Start-up

Article 73. The power-generating start-up includes the step and gradual increase in the power, the establishment and refining of the parameters of the active zone, the comprehensive testing of the reactor's systems and equipment, the covering of all stages in the planned experiments and the study of obtained results.

Article 74. All regulation systems, equipment and installations required for the reactor's operation must be accepted for use and the full documentation listed in Article 101 (excluding Points 1 and 2 of Article 101) must be ready prior to the power start-up.

Article 75. The power start-up of the reactor must be based on the power start-up program which must include any (eventual) corrections from the results of the physical start-up.

Article 76. The measures necessary for ensuring nuclear safety in the power start-up must be listed in the instructions on the reactor's operations.

Article 77. The power start-up program must stipulate the sequence of the procedure and describe the experiments. The experiments must include the experimental data as stipulated in Article 58, Paragraph 2, and data related to the power and temperature correlations. Methods for the conduct of the experiments and a plan-schedule for the power start-up must be formulated for the implementation of said program. The part of the program related to nuclear safety must be coordinated with the KMIAE.

Article 78. The readiness of the reactor's system and equipment for the power start-up must be checked by a work commission appointed by order of the reactor's manager. The commission must test the readiness of the reactor for the power start-up, the raising of the reactor to capacity as per Article 74, and the staffing, training and work permission applicable to the regular shift personnel. The commission must draw up a document certifying to the readiness of the reactor for the power start-up.

Article 79. The KMIAE must issue the permission for the power start-up in terms of ensuring nuclear safety on the basis of the following documents:

1. The power start-up program coordinated with the KMIAE;

2. The document drawn up by the work commission on the readiness of the reactor for the power start-up;

3. The document on the results of the physical start-up;

4. The document signed by the reactor's manager to the effect that faults noted in the remarks of the KMIAE commission, which prevented the power start-up and the stipulations of Article 63, if pertinent, have been corrected.

Article 80. On the basis of the document drawn up by the work commission on the reactor's readiness for power start-up and the permission issued by the KMIAE, the acceptance commission may allow the power start-up of the reactor.

Article 81. The power start-up must take place under the supervision of the reactor's manager. The work based on the program for the power start-up is performed by the reactor's personnel. If necessary, a special start-up group may participate in the performance of this project. The rights and duties of the members of the start-up group must be stipulated in a separate start-up group document.

Article 82. The reactor's manager is responsible for maintaining nuclear safety during the power start-up; the shift manager and the reactor's personnel are responsible for the nuclear safety during the shift, in accordance with official instructions.

Article 83. The results of the power start-up must be recorded in a document and a report, containing recommendations on the reactor's operations. The document and the report must be submitted to the KMIAE no later than 3 months from the acceptance of the project.

Article 84. The instructions on the operation of the reactor and the remaining technical documentation must be amended according to the results of the power start-up.

Chapter Four

Operation of the Research Reactor

Article 85. Prior to undertaking the reactor's operations the organization's management must coordinate with the KMIAE changes in designs and equipment structure, introduced after the physical and power start-ups, which may influence nuclear safety.

Article 86. (1) The reactor's operations may be allowed on the basis of a certificate issued by the KMIAE.

(2) In order for the certificate to be issued to the reactor's operating organization the following documents must be submitted to the KMIAE no later than 3 months following the initialling of the acceptance document:

1. The data stipulated in the appendix;

2. Thresholds and conditions for operational safety as per Article 88;

3. Reports on the results of the physical and power start-ups;

4. The reactor's operational instructions amended as a result of the physical and power start-ups.

(3) Any change in the parameters listed in the reactor's certificate can be made only after KMIAE clearance.

Article 87. The operation of the reactor and the experimental systems must be conducted strictly in accordance with the instruction on the operation of the reactor and the instructions on the operation of the experimental systems and equipment, which must be consistent with nuclear safety requirements.

Article 88. (1) The normal working conditions of the reactor (thresholds and safe operational conditions) must be based on the design-technical documentation and the results of the reactor's physical and energy start-ups.

(2) Should conditions constituting a nuclear danger arise, steps must be taken to restore the reactor's normal operating conditions or the breakdown safety system activated.

Article 89. The maximally possible reactivity, reactivity reserve and efficiency of the working parts of the control and safety system must be known at any given moment of the reactor's operations.

Article 90. Research involving the reactor and the installation of experimental systems must be based on approved programs and methods. The programs must include research procedures and measures for securing nuclear safety.

Article 91. The raising of the reactor to a critical condition and power are allowed on the basis of the following minimal requirements:

1. The power control must be consistent with the stipulations of Article 36;

2. The reactor's breakdown safety must be consistent with the stipulations of Articles 38 and 42;

3. The effectiveness of the working parts of the control and safety system must be consistent with the stipulations of Article 31;

4. The working parts of the breakdown safety system must be in a state of readiness;

5. The signalling system must meet the stipulations of Article 9;

6. The normal and emergency power supply and cooling and the control-measuring instruments and equipment must be functional.

Article 92. (1) All operations in the active zone of a non-operational reactor must be kept under steady supervision which must include the following, in accordance with the stipulations of Article 36:

1. The neutron flow;

2. Velocity of power or reactivity increase;

(2) No control of a stopped reactor with heat generating elements in the active zone is necessary, providing that no operations involving the reactor are carried out. In such cases:

1. The reactor must be dampened, including all regulation working parts of the control and safety system; the power of their instruments must be cut off and the electric power supply of the control and safety system turned off;

2. The subcritical condition of the reactor must be consistent with the stipulations of Article 46. Additional measures for ensuring the required subcritical condition require removing some of the nuclear fuel from the active zone, the installation of additional absorbers and control over the level of the reactor's delayer.

Article 93. The management of the organization operating the reactor must approve the list of assemblies, systems and equipment which ensure the

reactor's nuclear safety and determine the periodicity of their testing and supervision.

Article 94. (1) Operations which influence the reactivity of the active zone, such as reloading, repairs, removing and installing operational equipment, etc. are considered nuclear threats and must be carried out strictly in accordance with the nuclear safety regulations and control over the reactor's condition.

(2) Only one reloading operation at a time is permitted.

Article 95. (1) Nuclear-dangerous operations must be conducted with a stopped reactor on the basis of a special technical decision approved by the reactor's manager. The decision must include the following:

1. A list of nuclear-dangerous operations;

2. Technology governing nuclear-dangerous operations;

3. Technical and organizational measures ensuring nuclear safety.

(2) The activating or stopping of experimental systems or reactor models operating at capacity in stationary conditions are allowed, providing that the velocity of reactivity increase does not exceed 0.07β ef/sec.

Article 96. The technology used in nuclear-dangerous operations repeatedly performed with the reactor (replacement or repairs of working parts of the control and safety system, reloading the fuel, etc.) may be described in the instruction on the reactor's use. The drafting of technical stipulations is not required in this case.

Article 97. (1) Nuclear-dangerous operations with a non-functioning reactor must be conducted with engaged breakdown safety working parts. In such cases:

1. The subcritical condition of the reactor must not be under 0.01 for the condition of the active zone with a maximally effective multiplication coefficient;

2. The neutron-flow control must be secured;

3. The breakdown safety channels must be in operating condition.

(2) The recharging of the reactors' fuel, which is done while the control and safety system is disconnected, must take place with engaged working parts in the active zone. The minimal subcritical state of the recharged reactor must be no less than 0.02, taking possible errors into consideration.

Article 98. Nuclear-dangerous work must be performed by the shift personnel under the supervision of the shift manager.

Article 99. The charging of the new active zone must be done according to the regulations for assembling a critical mass as per Articles 66 and 67.

Article 100. Following the repair of the equipment and the systems affecting the reactivity of the active zone and the reactor's nuclear safety, the repairs must be checked for consistency with approved features.

Article 101. The required documentation for the use of the reactor must include the following:

1. The document of the acceptance commission on activating the reactor;

2. The certificate of the research reactor, issued by the KMIAE;

3. The instruction on the use of the reactor;

4. The instruction on the operation of the experimental systems;

5. The instruction on operating the reactor's systems and equipment;

6. The technical documentation for the reactor and the experimental systems, which must include descriptions and diagrams of the equipment and systems for nuclear safety;

7. Documents and records on the testing of the equipment and the systems for nuclear safety;

8. The instruction on the transportation and storage of the fresh and spent nuclear fuel;

9. A plan for emergency measures;

10. Job instructions for the reactor's shift personnel and for each individual workplace;

11. Records on the tests administered and instructions given to the shift personnel;

12. The order issued by the reactor's management allowing the shift personnel to operate on their own;

13. The operative documentation which includes the logbooks, the diary with the chart for loading the active zone, diagrams, etc.;

14. The list of the documents applicable to the reactor, certified by the reactor's manager.

Article 102. The managements of the respective ministries and other departments and organizations are responsible for ensuring nuclear safety in the operation of the reactor.

Article 103. The reactor's operator has the right to stop it on the basis of his own judgement, should he determine that its continued use constitutes a danger.

Chapter Five

Transportation and Storage of Fresh and Spent Nuclear Fuel in the Reactor's Area

Article 104. (1) The transportation and storage of the fresh and spent nuclear fuel must be consistent with the stipulations of the instruction on the transportation and storage of fresh and spent nuclear fuel.

(2) The norms and procedures governing the transportation and storage of the fuel must be described in the reactor's design.

Article 105. The location of the heat generating cassettes on shelves in storing the fresh fuel must be such as to ensure a subcritical condition no lesser than 0.05 in view of possible breakdown situations, including the flooding of the storage areas.

Article 106. The following must be observed in the transportation and storage of the spent nuclear fuel:

1. A subcritical condition of no less than 0.05 for all emergency situations must be maintained;

2. The possibility of its melting from residual energy release must be excluded.

Article 107. Each individual transportation-technological operation related to the moving of fresh or spent heat releasing cassettes must be recorded in a special logbook with an indication of their location.

Chapter Six

Reactor's Personnel

Article 108. The reactor must be operated by the personnel of the shift (shift personnel).

Article 109. (1) The shift personnel are allowed to operate on their own after practical training in their specific duties and after passing the qualification examinations on knowledge of the job and operative instructions.

(2) The shift personnel are allowed to engage in independent operations by order of the reactor's manager.

Article 110. (1) The reactor's manager must approve the program for qualification examinations, the examination commissions' staffs and the training procedure.

(2) The program for the qualification examinations of the reactor's personnel must include the following parts:

1. A theory course in the specialty;

2. The reactor's design and its basic systems and structures;

3. The design of the experimental structures;

4. The functional diagram of the control and safety system, and the description of the control and safety system channels;

5. The physical features of the reactor;

6. The dynamic behavior of the reactor in stationary, transitional and breakdown conditions;

7. The design and operational principles of the systems and facilities ensuring the reactor's nuclear safety;

8. The reactor's documentation.

Article 111. Every 2 years or after work interruption in excess of 3 months the shift personnel must take a control examination.

Article 112. The examination of the shift manager and reactor's operators must be administered by a commission chaired by the reactor's manager; the examination of the personnel operating the technological services must be administered by a commission chaired by the head of the respective service with the participation of the head of the operational service.

Article 113. The duties of the shift personnel are stipulated in the job instructions. The entire personnel must be familiar not only with their own duties but with the duties of their immediate managers and subordinates.

Article 114. The shift personnel are under the operative command of the shift manager and must obey exclusively his orders.

Chapter Seven

Actions of the Reactor's Personnel in Breakdown Situations

Article 115. Should a nuclear-dangerous situation or nuclear breakdown develop, the reactor's personnel must act in accordance with the breakdown instruction measures and plan.

Article 116. The breakdown measures plan includes a description of various breakdown situations and their possible consequences and stipulates measures for their elimination.

Article 117. The breakdown measures plan must include the following actions in the case of an actual or suspected breakdown:

1. Stopping the reactor;

2. Evacuation of the personnel from the dangerous area;

3. Assessment of the radiation situation;

4. Localizing the breakdown;

5. Notifying the management of the organization operating the reactor;

6. Informing the KMIAE.

Article 118. The opening of the control-measuring equipment and changes in the thresholds for engaging the breakdown and warning signal and safety systems is forbidden from the moment of the breakdown to the beginning of the work of the commission in charge of investigating the causes of the breakdown.

Article 119. Whenever a nuclear-dangerous situation develops the KMIAE must be informed immediately. A record must be kept describing the circumstances of the breakdown and the reasons for the same must be analyzed and corrected. A copy of the proceedings must be supplied to the KMIAE within 1 month's time.

Chapter Eight

Control and Inspection of Nuclear Safety of a Research Reactor

Article 120. The ministries and other departments and organizations managing the research reactor must take measures aimed at ensuring nuclear safety and organize control over their implementation.

Article 121. Periodically, but no less than once a year, by order of the reactor's manager a commission in charge of investigating the nuclear safety condition of the reactor must be appointed. The document drawn up by the commission must be ratified by the reactor's manager and a copy of it must be sent to the KMIAE.

Article 122. The KMIAE must supervise the state of the reactor's nuclear safety.

Additional Stipulations

No 1. The meaning of some of the terms used in the present regulation is as follows:

1. A research reactor is a nuclear reactor used as a source of radioactive radiation. It contains equipment and systems required for scientific and technical research;

2. The control and safety system is a technological system of the reactor consisting of systems for controlling the power (intensiveness of the chain reaction), controlling the chain reaction and breaking the chain reaction in an emergency;

3. The control-measuring instruments and apparatus are systems for controlling the technological parameters in operating the reactor, such as temperature, pressure, expenditure of heat carriers, etc.;

4. Breakdown safety is a system for control and safety aimed at the automatic or remote-controlled fast breaking of the chain reaction;

5. The automatic regulator is a structure within the control and safety system, automatically controlling the reactor's power;

6. The compensating part or manual regulator is a remote-controlled structure of the control and safety system. It is used for compensating reactivity, and regulating and distributing the release of energy in the active reactor zone;

7. A working part in the control and safety system is a remote-controlled system the manipulation of which or change of conditions in the active zone or the reflector result in changes in the reactor's reactivity;

8. A group of working parts means working parts sharing a common independent drive;

9. The local critical mass is the quantity of nuclear fuel in the area of the active zone within the range of which an uncontollable self-generating chain reaction may appear;

10. The physical start-up of the reactor is the initial loading of the active reactor's zone with regulation heat generating elements or cassettes, the raising of the reactor to a critical condition and the performance of the necessary experiments on the level of capacity in which the heating of heat generating elements is insignificant;

11. The energy start-up of the reactor means reaching the reactor's capacity level as a result of the physical start-up up to the stipulated operational power level and the conduct of the necessary experimental studies to determine the operational features of the reactor;

12. A nuclear breakdown is a breakdown related to the damaging of heat generating elements in excess of the admissible thresholds, caused by:

a) Loss of control over the fission chain reaction in the active reactor zone;

b) Formation of a critical mass in the first contour of the reactor or in the course of the transportation and storage of the nuclear fuel;

c) Disturbance in the cooling of the nuclear fuel;

13. A nuclear-dangerous condition means deviation from the thresholds and conditions of nuclear safety in the operation of the reactor, which has not led to a breakdown;

14. The maximally possible reactivity is determined for the moment of the campaign and condition of the reactor with a maximal multiplication coefficient and is the maximal reactivity which may be developed in the reactor in deactivating the working parts of the control and safety system and

the other neutron absorbers located in the active zone and the reflector and activating the moving parts of the reactor resulting in a reactivity increase;

15. The reactivity reserve is the highest reactivity of the reactor which may be obtained in deactivating the working parts of the control and safety system;

16. The experimental structures are structures used in conducting scientific and technical reactor studies;

17. The reloading operation means work done in the reactor in moving the heat generating cassettes, the reflector, the working parts of the control and safety system, the operational systems, and others to the active zone or the reflector with a view to their replacement, repair, assembling, disassembling, and others.

No 2. Violators of the present règulation will be held liable as per Article 5 of the Ukase on State Nuclear Safety Control (DV, No 54, 1980).

Concluding Stipulations

No 3. The present regulation is issued on the basis of Article 2 of the Ukase on State Nuclear Safety Control (DV, No 54, 1980) and is formulated on the basis of the nuclear safety regulations for research reactors, approved by the CEMA Permanent Commission on the Utilization of Nuclear Energy for Peaceful Purposes, recommended for use by CEMA countries (Point VII of the minutes of the 35th Permanent Commission Session, dated November 1978).

No 4. The present regulation is mandatory for all ministries and other departments and organizations in designing, building, starting-up and operating research reactors.

No 5. The respective managements of the ministries and other departments, organizations and individuals engaged in activities as per No 4 shall bear the responsibility for observing the stipulations of the present regulation.

Chairman: N. Papazov.

Appendix to Article 86, Paragraph 2, Point 1:

Required Data for Issuance of a Research Reactor Certificate

1. Name of the reactor...

2. Purpose of the reactor..

3. Organization operating the reactor..

4. Date of commissioning...

5. Reactor capacity in kwt...

6. Reactor's active zone...

a) Nuclear fuel...

b) Delayer...

c) Reflector...

d) Heat carrier...

e) Effective diameter, cm...

f) Height, cm...

g) Number of heat generating elements.................................

h) Minimal number of heat generating elements for a given capacity.......

7. Physical parameters of the active zone:

a) Maximally possible reactivity (βef).................................

b) Reactivity reserve (βef)...

c) Total reactivity of the working parts of the control and safety system in an active zone with maximally possible reactivity (βef)...........

d) Sign and value of the full power reactivity coefficient with working parameters of the active zone...

e) Subcritical level of the active zone with disconnected working safety parts in the active zone with a maximal effective multiplication coefficient ($\frac{\Delta k}{k}$)...

8. Description of the reactor's control and safety system:

a) Working parts

Working parts	No of groups	No of working groups per group	Group effectiveness β_{ef}	Increase in reactivity speed in disconnecting work groups, βef/sec	Time of engagement of working parts with breakdown safety signal, seconds
Breakdown safety					
Automatic control					
Compensation					

b) Additional systems for influencing reactivity........................

c) Breakdown safety channels (number and type)...........................

d) Capacity control channels (number and type)...........................

9. Type of experimental systems..

5003
CSO: 2202/13

MINISTER ASSESSES SCIENCE'S ROLE IN ECONOMIC DEVELOPMENT

PAP Warsaw DAILY NEWS in English No 88, 5 Mar 83 pp 9-11

[Article by Stanislaw Filipczak]

[Text] Between 1971 and 1980 Poland purchased 428 foreign licences, while in the years 1981-82 it made no such purchases. By the end of last year, 34 licences had been bought earlier were still in the process of introduction, and the implementation of 38 licences was halted following cuts in expenditure on investment.

Revealed by Minister of Science, Higher Schools and Technology, Benon Miskiewicz, at a meeting with journalists here today, the above data underscore the necessity for fuller utilization of the Polish scientific and research potential, which, as Minister Miskiewicz pointed out, is not yet used to the extent called for by the present crisis and inflation.

This justifies the launching of an active policy with regard to science and technology, said Minister Miskiewicz.

The material situation in the field of science at the moment is difficult. The proportion of the national income earmarked annually for science is 1.8 percent. The state of science is far from satisfactory as regards equipment and hard currency funds. Appropriate action is necessary to remedy the situation to enable science to contribute more to the requirements of the state.

The 3-year plan provides for an increase of financial means for the development of science and technology in 1985 by 30 percent compared with 1982. Total outlays in this field will go up from 71.1 billion zlotys in 1983 to 85.1 billion zlotys in 1985. The budgetary expenditure for this purpose is expected to stay in the unchanged level of 29.1 billion zlotys, while expenditure on technological and economic progress, as well as economic organisations, will increase substantially.

The Ministry of Science, Higher Schools and Technology has taken up an active policy to enable science and technology to contribute more to the satisfaction of the country's needs. This policy will cover a short-term period ending in 1985, and a long-term period running until 1995 or the year 2000.

The point is to ensure that in the initial period the scientific community will make a concrete contribution to the solving of the most pressing social and economic problems. By the year 2000 the principles and methods of steering the development of science and technology in Poland will be of considerable importance.

Of the scientific and research undertakings listed in the national socio-economic plan for 1983-85, 25 percent is related to tasks connected with the food program, 27 percent, to cost-conscious use of raw materials, components, fuels and energy, and 36 percent, to tasks linked with the expansion of export and rationalization of imports. Almost 12 percent are for tasks related to construction, health care and natural environment.

The full cost of these undertakings in 1983-85 is estimated at about 16 billion zlotys, the cost of launching these projects into practice is estimated at nearly 130 billion zlotys, while the effects expected after 1985 are estimated at over 270 billion zlotys. The resulting import cuts are valued at about 60 million dollars.

Exports of Polish know-how are another problem. At the end of last year Poland came up with a large export offer to the developing countries. Offers were also sent to the Soviet Union, Czechoslovakia and other socialist countries. The Polish side is now waiting to get orders from the parties concerned.

CSO: 2020/30

BRIEFS

POLAR RESEARCH EXPEDITION--The 6th expedition of Polish polar scientists returned to Gdynia aboard the ZAWICHOST ship of the Polish Ocean Lines. The 9-person research team from the Ecology Institute of the Polish Academy of Sciences (PAN) spent 364 days at the H. Arctowski base on King George Island. Participants in the winter party to the southern Shetlands Archipelago continued their comprehensive research into the Antarctica's ecological system, using new elements of observation in botany and ichthyology. Polish scientists maintained permanent radio contact with the nearby Soviet, Argentine and Chilean polar stations. Head of the team, Dr Ryszard Wroblewski, took part, as PAN official representative, in an international conference of Antarctic states held at the Chilean polar base located several dozen kilometers away from the Polish station. The participants in this conference, coming from 16 states, visited the Polish station. [Text] [PAP Warsaw DAILY NEWS in English No 88, 5 May 83 pp 1, 2]

CSO: 2020/29

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